

## COST AND PERFORMANCE REPORT

### EXECUTIVE SUMMARY

This report presents cost and performance data for a thermal desorption/dehalogenation treatment application at the Wide Beach Development Superfund site (Wide Beach) in Brant, New York. Contamination of soil at the Wide Beach site resulted from the spraying of waste oil containing polychlorinated biphenyls (PCBs) over the roadways in the community to control dust. A Record of Decision (ROD), signed in 1985, required excavation, stockpiling, and treatment of soil from areas including roadways, drainage ditches, and residential yards where concentrations of PCBs were greater than 10 mg/kg. In response to the ROD and a 1988 interagency agreement between EPA and the U.S. Army Corps of Engineers (USACE), SoilTech's mobile anaerobic thermal processor (ATP) system was used in conjunction with alkaline polyethylene glycol (APEG) dechlorination to treat contaminated soil at this site. The USACE specified that the concentration of PCBs in soil treated at Wide Beach should not exceed 2 mg/kg.

The system was operated from October 1990 to September 1991. Approximately 42,000 tons of stockpiled soil contaminated with PCBs, mainly Arochlor 1254, at concentrations ranging from 10 to 5,000 mg/kg, were treated. The Wide Beach project is notable for being the first full-scale treatment application using SoilTech's ATP system in conjunction

with APEG dechlorination to treat soil at a Superfund site contaminated with PCBs.

The SoilTech ATP system used at Wide Beach consisted of a feed system, the ATP unit (a rotary kiln thermal desorber), a vapor recovery system, a flue gas treatment system, a tailings handling system, and a module for preparing reagents used for the APEG dechlorination process. Wastewater from the vapor recovery system was treated on-site and then disposed of at an off-site treatment facility. Waste oil from the vapor recovery system containing PCBs was dechlorinated using APEG and then recycled as carrier oil in the vapor recovery system. An EPA SITE Demonstration, conducted during the full-scale operation in May of 1991, indicated that 98 percent of the PCBs that entered the ATP system were dechlorinated.

The thermal description system at Wide Beach achieved the specified soil cleanup standards. Concentration of PCBs in treated soil samples were generally at or below the reported detection limit of 0.5 mg/kg. However, treated soils could not be used as backfill, because they were not as cohesive as the excavated soil, and were disposed of off site as nonhazardous waste.

The costs for the treatment application at Wide Beach, excluding costs for construction of a concrete pad for the ATP unit and for off-site disposal of the treated soil, were \$11,600,000.

## SITE INFORMATION

### Identifying Information

Wide Beach Development Superfund Site,  
Brant, New York

**CERCLIS #:** NY0980652259

**ROD Date:** September 30, 1985

### Treatment Application

**Type of Action:** Remedial

**Demonstration Test Associated with Application?** Yes (see Appendix A and Reference 4)

**EPA SITE Program Test Associated with Application?** Yes (see Reference 9)

**Period of Operation:** October 1990 to September 1991

**Quantity of Soil Treated During Application:**  
42,000 tons

### Background

**Historical Activity That Generated Contamination at the Site:** Spraying of waste oil over roadways for dust control. [7]

**Corresponding SIC Codes:** Not applicable  
**Waste Management Practice that Contributed to Contamination:** Road Oiling - Application of PCB-containing waste oils to the roadways for dust control.

**Site History:** The Wide Beach Development Superfund Site (Wide Beach) is a 55 acre, lake-side community located in Brant, New York, as shown on Figure 1. From 1964 until 1978, waste oil containing polychlorinated biphenyls (PCBs) was applied to the roadways in the community to control dust. Soil from the roadways was excavated during the installation of a 1-mile sanitary sewer trench in the community during 1980. Excavated soil was used as fill in several residential yards. [7]

An Erie County Department of Environment and Planning investigation of an odor complaint led to the discovery of 19 drums in a wooded area in the Wide Beach Development community. Two of the drums contained waste oil contaminated with PCBs. Further investigation revealed that PCBs were present in soil from roadways and residential yards, in vacuum cleaner dust from residential homes, and in water from residential wells. The Wide Beach Development site was placed on the National Priorities List in September 1983. [7]

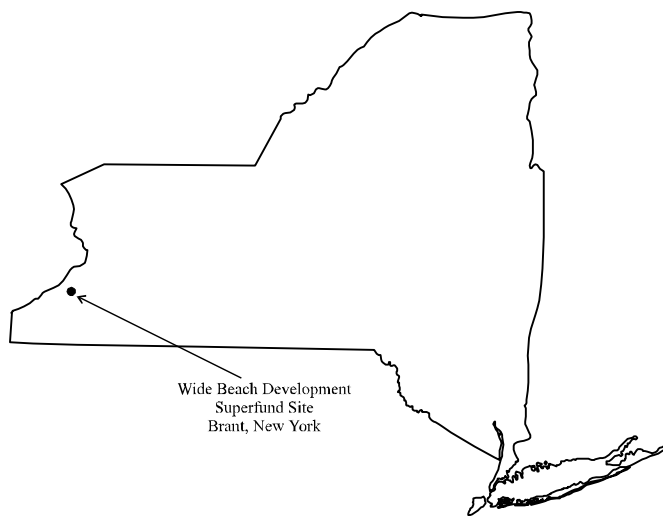


Figure 1. Site Location

A remedial investigation and feasibility study (RI/FS) was conducted from 1984 to 1985.

[18] The RI/FS results indicated that:

- PCBs (mainly Arochlor 1254) were the major contaminants;
- The highest PCB concentrations were detected in soils from the roadways, drainage ditches, driveways, and front yards;
- Concentrations of PCBs in water from residential wells were in the parts per billion range or less;
- PCBs were transported mostly by surface water;
- Contaminated soils would act as a long-term source of PCBs; and
- Human exposure to PCBs was possible through ingestion of contaminated vegetation and/or soil, inhalation, and dermal absorption.

Based on these results, EPA implemented a removal action, which was conducted from June to July 1985. The removal action included paving roadways, drainage ditches, and driveways, shampooing and vacuuming rugs, replacing air conditioner and furnace filters in residential homes, and installing

## SITE INFORMATION (CONT.)

### Background (cont.)

particulate filters in residential wells to prevent further exposure of the public to PCBs. [7]

Long-term remedial measures were subsequently specified in a 1985 Record of Decision (ROD). Remedial measures were conducted from 1986 until 1991.

Several activities took place relative to the implementation of the ROD requirement of chemical treatment for contaminated soil at Wide Beach.

From May 1986 to February 1989, Ebasco Services, Inc., and Galson Research Corporation conducted bench- and pilot-scale treatability studies to determine the suitability of potassium polyethylene glycol (KPEG) dechlorination as a chemical treatment process. These studies were completed using a batch process, including blending of contaminated soil with KPEG for at least 12 hours, centrifugation of the mixture to recover the dechlorination reagents, and then washing of the soil. [8]

In December 1988, EPA and the United States Army Corps of Engineers (USACE) signed an interagency agreement for the procurement of a remedial action (RA) contractor and management and administration of the RA contract by the USACE. The RA contract developed by the USACE specified that all excavated soils must be treated using a chemical treatment process. Additionally, the contract specified that the concentration of PCBs in soil treated with this process should not be greater than 2 mg/kg and specified that all work be performed in conformance with applicable Federal, State, and local requirements. [8]

In October 1989, Kimmins Thermal Corporation (Kimmins) was awarded the RA contract for the Wide Beach site. Kimmins subsequently submitted a Value Engineering Change Proposal in February 1990 suggesting the use of a continuous process consisting of treatment of soil using SoilTech's Anaerobic Thermal Process (ATP) combined with EPA's APEG

dechlorination process, instead of the batch KPEG process, for remediating soil at the Wide Beach site. The ATP/APEG process was preferred by Kimmins because the APEG process could be accelerated by the combination of vigorous mixing and higher temperatures in the ATP unit. This process was subjected to a demonstration test in September 1990 and stack gas testing on October 4 and 5, 1990. Based on the results of these tests the ATP/APEG process was found to be acceptable to EPA and the USACE. The soil remediation at the Wide Beach site using the ATP/APEG process was conducted from October 1990 to September 1991. [8]

**Regulatory Context:** The September 1985 ROD identified the following long-term remedial measures for the site [7]:

- Excavation and chemical treatment of contaminated soil from roadways, drainage ditches, driveways, yards, and wetlands containing PCB concentrations greater than 10 mg/kg;
- Sampling for PCBs in soils from residential yards, sewage in a lift station near the site, and sediments in disconnected septic systems to accurately define the extent of PCB contamination;
- Pilot-scale testing to determine an effective treatment scheme for chemically treating the PCB-contaminated soils;
- Backfilling the treated soil into the excavated areas;
- Treatment of water from the sewer trench;
- Construction of a hydraulic barrier at the end of the sewer trench;
- Disposal of contaminated asphaltic material and reuse of uncontaminated asphaltic material for repaving roadways and driveways; and
- Repaving roadways and driveways.

**SITE INFORMATION (CONT.)****Site Logistics/Contacts**

**Site Management:** Fund - Lead (remedial design activities)

USACE - Lead (Contract Administration)

**Oversight:** EPA

**Remedial Project Manager:**

Herb King

USEPA, Region 2

26 Federal Plaza

New York, NY 10278

(212) 264-1129

**U.S. Army Point of Contact:**

Joe Salvatore (primary contact for this application)

USACE

c/o 914 TAG, Building 322

Niagara Falls International Airport

Niagara Falls, NY 14304

(716) 297-8531

**Treatment Vendor:**

Joseph Hutton

SoilTech ATP Systems, Inc.

800 Canonie Drive

Porter, IN 46304

(219) 926-8651

**MATRIX DESCRIPTION****Matrix Identification**

**Type of Matrix Processed Through the Treatment System:** Soil (ex situ)

**Matrix Characteristics Affecting Treatment Cost or Performance [9]**

The major matrix characteristics affecting cost or performance for this technology and their measured values are presented in Table 1.

Table 1. Matrix Characteristics [9,28]

Parameter	Value	Measurement Procedures
Soil Classification	Silt/Loam	Not Reported
Bulk Density*	2.10 g/cm	Not Reported
Clay Content	12.8%	ASTM D-421/422
Silt Content	30.3%	ASTM D-421/422
Moisture Content	18.3%	ASTM D-2116
pH*	7.7	Not Reported
Particle Size Distribution* (cumulative % by weight finer)		
4.75 mm	85.9	Not Reported
20 mm	76.2	
0.425 mm	68.0	
0.075 mm	48.6	
0.005 mm	18.8	
Lower Explosive Limit	Not Available	.
Oil and Grease or Total Petroleum Hydrocarbons	Not Available	.

\*These values are the average results for three composite samples of the contaminated feed collected during the three test runs of the SITE Demonstration conducted in May 1991. These values are from the SITE Demonstration only, during which 104 of the 42,000 tons of contaminated soil from Wide Beach were tested.

**Contaminant Characterization****Primary contaminant groups:** PCBs

The concentration of PCBs measured in the soils stockpiled for treatment ranged from approximately 10 to 5,000 mg/kg. PCB

concentrations measured in the material fed to the ATP unit ranged from 11 to 68 mg/kg. PCBs were measured in the untreated (stockpiled) soil using EPA Method 8080. [16, 19]

## TREATMENT SYSTEM DESCRIPTION

### Primary Treatment Technology Type

Thermal Desorption/Dehalogenation

### Supplemental Treatment Technology Types [9]

**Post-treatment (air):** The ATP system used at Wide Beach included two off-gas treatment systems.

The flue gas treatment system, designed to treat gases from the combustion zone of the ATP unit, included the following technologies:

- Cyclone;
- Baghouse;
- Acid gas scrubber; and
- Carbon adsorption.

The vapor recovery system, designed to treat gases from the preheat and retort zones of the ATP unit, consisted of the following technologies:

- Cyclone;
- Scrubber;
- Fractionator;
- Condenser; and
- Gas-oil-water separator.

**Post-treatment (water):** The condensed water from the vapor recovery system was treated in an on-site wastewater treatment system utilizing sand filtration, clay and anthracite coal filtration, primary oxidation, gravity settling, secondary oxidation, air stripping, and carbon adsorption.

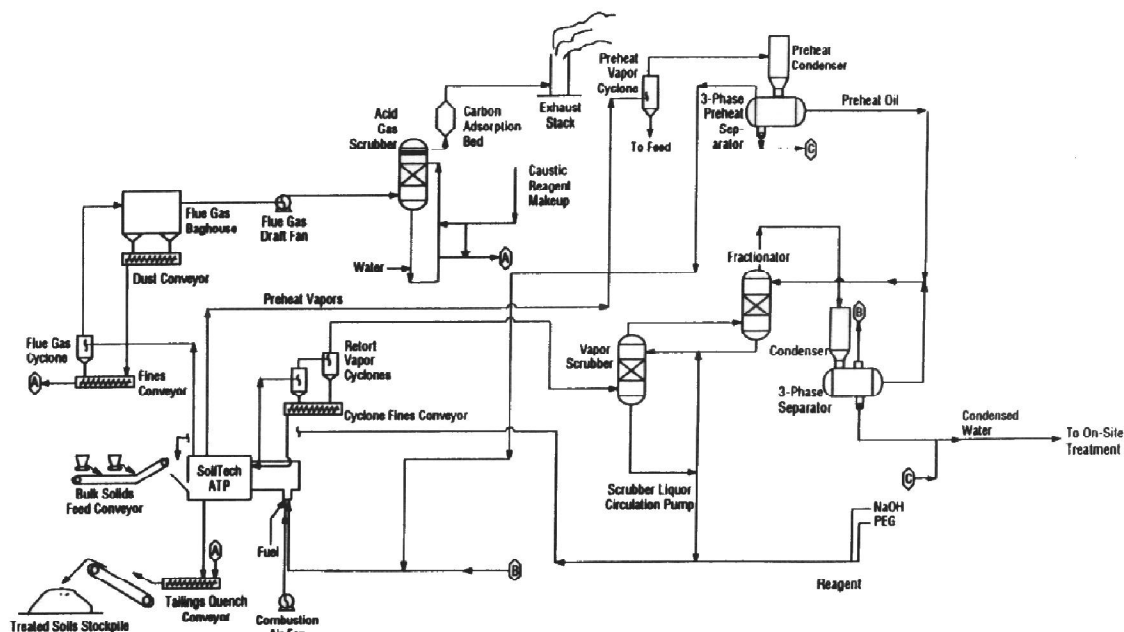


Figure 2. ATP Schematic [9]



## TREATMENT SYSTEM DESCRIPTION (CONT.)

### ATP/APEG Process Description and Operation [7,9,27,28] (cont.)

cooling zone where they were cooled to an appropriate exit temperature.

The primary innovative features of the ATP unit are the four internal zones and the use of proprietary sand seals at each end of the retort zone which are designed to maintain an oxygen-free environment in the retort zone, and to prevent the oxidation of hydrocarbons and coke.

The vapor recovery system consisted of two parallel systems. One system condensed water and vapors from the preheat zone of the ATP unit. This system consisted of a cyclone, a condenser, and a gas-oil-water separator. The other system condensed water and vapors from the retort zone and consisted of two cyclones, a fines conveyor, a scrubber, a fractionator, a condenser, and a gas-oil-water separator.

At Wide Beach, condensed water from the vapor recovery system was treated in an on-site wastewater pretreatment system which consisted of the following treatment processes: sand filtration; clay and anthracite coal filtration; primary oxidation using sodium hypochlorite; settling; secondary oxidation with sodium hypochlorite; air stripping; and carbon adsorption. The wastewater discharged from this system was further treated in an off-site commercial treatment system.

The waste oil from the vapor recovery system containing PCBs was dechlorinated using APEG and then recycled as carrier oil in the vapor recovery system. At the end of the project, waste oil remaining in the vapor recovery system was disposed off site.

The flue gas treatment system consisted of a cyclone, fines conveyor, baghouse, dust conveyor, acid gas scrubber and activated carbon unit. This system removed particulates and trace hydrocarbons from the flue gas exiting the combustion zone of the ATP. Fines from the baghouse and cyclone were mixed with the treated solids exiting the ATP unit. The treated flue gas was released to the atmosphere.

The tailings (treated solids) handling system was used to cool and remove treated solids from the ATP. The treated solids exiting the ATP were quenched with process and scrubber water and transported to storage piles using belt and screw conveyors.

The ROD specified that the treated solids were to be used to backfill the excavated areas of the site; however, the treated solids exhibited less cohesiveness than the excavated soil and were not suitable for backfilling. The loss of cohesion was possibly due to the high silt and clay content and the presence of expansive interlayered illite/smectite clay.

At Wide Beach, the ATP unit was operated continuously (24 hours a day and 7 days a week) excluding system down time to repair the mechanical problems discussed below (approximately two months) and to perform routine maintenance (approximately three days per month).

During the treatment application at Wide Beach, the unit was shut down for approximately two months because the inner kiln of the ATP unit cracked due to heat and mechanical stresses during operation. During that time, the geometry and metallurgy of the inner kiln was modified, the burner system was redesigned to reduce heat stresses, and a second drive system was installed to reduce the mechanical stresses on the existing drive system. After making these modifications, the inner kiln did not crack again during the remainder of the treatment application at Wide Beach.

During treatment, problems were encountered with steel debris interfering with the retort zone sand seal in the ATP unit. Also, conglomerated soil was clogging the feed hopper. A soil pretreatment system was added to shred large pieces of conglomerated soil and remove steel debris. The pretreatment system consisted of an asphalt grinder for crushing soil conglomerates to feed particle sizes of less than 2 inches and a magnet for removing steel debris from stockpiled, contaminated soil.

## TREATMENT SYSTEM DESCRIPTION (CONT.)

### ATP/APEG Process Description and Operation [7,9,27,28] (cont.)

Prior to the demonstration test conducted in September 1990, SoilTech discovered that a number of the filter bags in the baghouse were torn due to excessive wear from previous operations. During the test, SoilTech tied off the damaged bags. SoilTech indicated that the baghouse had adequate capacity to operate with the damaged bags off-line. After discovering that the particulate emissions had exceeded the NYDEC air permit level during the demonstration test, SoilTech determined that several damaged bags had not been tied

off. SoilTech subsequently replaced all of the filter bags in the baghouse prior to stack gas testing requested by the USACE and conducted the tests on October 4 and 5, 1990. The average particulate emissions measured during the October 1990 stack gas tests (0.03 gr/dscf, based on three stack gas tests) were less than one-tenth the average particulate emissions measured during the September 1990 stack gas tests (0.32 gr/dscf, based on two stack gas tests).

### Operating Parameters Affecting Treatment Cost or Performance

The major operating parameters affecting treatment cost or performance for this technology and their values measured during

this treatment application are presented in Table 2.

Table 2. Operating Parameters\* [9,25]

Parameters	Value	Measurement	Method
Operating Pressure	Negative Pressure	Not Available	
Preheat and Retort Zone Residence Time	30 – 40 minutes	Not Available	
Retort Zone Temperature	1,160 F	Thermocouples in the Retort Zone	
Combustion Zone Temperature	1,293 F	Thermocouples in the Combustion Zone	
Cooling Zone Temperature	434 F	Thermocouples in the Cooling Zone	
System Throughput	Not Available	Not Available	

\*The values presented in Table 2 are the average results for the three test runs of the SITE Demonstration. According to the USACE, these values were held fairly constant during the entire course of the soil remediation at Wide Beach. [9,25]

Other parameters measured during the SITE Demonstration were the stack gas flow rate (5,275 standard cubic feet per minute (scfm))

and the preheat and retort zone off-gas flow rates (203 and 109 actual cubic feet per minute (acfm), respectively). [9]



## TREATMENT SYSTEM DESCRIPTION (CONT.)

### Timeline

The timeline for this application is presented in Table 3.

Table 3. Timeline

Start Date	End Date	Activity
September 30, 1985	—	ROD signed
May 1986	February 1989	Treatability Studies of KPEG conducted
September 7, 1990	September 8, 1990	Demonstration test of the ATP/APEG process performed
October 4, 1990	October 5, 1990	Stack gas tested for particulate emissions.
October 1990	September 1991	Full-scale operation of the ATP/APEG process
December 1990	January 1991	System shut down - the inner kiln of the ATP unit cracked due to thermal and mechanical stresses. The geometry and metallurgy of the inner kiln was improved to allow use of combustion zone temperature up to 1,500 F.
May 1991	—	SITE Demonstration conducted

## TREATMENT SYSTEM PERFORMANCE

### Cleanup Goals Standards

The Remedial Action (RA) contract developed by USACE specified a maximum concentration of 2 mg/kg for PCBs in treated soil and that all remediation work be performed in conformance with applicable Federal, State and local requirements. [17]

Applicable Federal, State, and local requirements include air emission requirements for stack gases. The New York Department of Environmental Conservation (NYDEC) specified the following stack emission requirements for the ATP unit used at Wide Beach [4]:

- PCBs:  $3.33 \times 10^{-5}$  pounds per hours (lb/hr);

- Polyethylene glycol (PEG):  $4.16 \times 10^{-5}$  lb/hr; and

- Particulates: 0.05 gr/dscf.

The ROD specified that contaminated soils from roadways, drainage ditches, driveways, yards, and wetlands containing more than 10 mg/kg of PCBs were to be excavated and chemically treated.

The RA contract required a PCB cleanup level of 2 mg/kg be verified by collecting one sample from the treated soil staging area for every 100 tons of soil treated. These samples were collected by inserting a stainless steel tube into the staging pile. [17, 19]

### Treatment Performance Data

Table 4 summarizes the analytical results for PCBs (measured in an on-site laboratory using EPA Method 8080) in untreated and treated soil during the treatment application at Wide Beach. [19, 24]

Results for stack gas emissions of PCBs, PEG, and particulates are presented in Appendix A.

Although no treatment standard or action level was set for dioxins/furans in stack gas emissions, these constituents were measured in the SITE Demonstration. [28] Table 5 shows dioxin and furan stack gas emissions measured during the SITE Demonstration. [9]

## TREATMENT SYSTEM PERFORMANCE (CONT.)

### Treatment Performance Data (Cont.)

Table 4. PCB Results [19, 24]

	Range of PCB Concentrations (mg/kg)	Number of Data Points	Number of Detects	Number of Detects Greater than 2 mg/kg
Untreated soil	11-68	42	41	41
Treated soil	ND(0.4)-21	520	196	0

ND = Not detected. Number in parenthesis is the reported detection limit.

Table 5. Dioxin and Furan Stack Gas Emissions [9]

Compound	Stack Gas (ng/dscm)
Tetrachlorinated dibenzo-p-dioxins (TCDD)	0.14
Tetrachlorinated dibenzofurans (TCDF)	4.8
Pentachlorinated dibenzo-p-dioxins (PeCDD)	0.96
Pentachlorinated dibenzofurans (PeCDF)	0.72
Hexachlorinated dibenzo-p-dioxins (HxCDD)	0.17
Hexachlorinated dibenzofurans (HxCDF)	0.077
Heptachlorinated dibenzo-p-dioxins (HpCDD)	0.25
Heptachlorinated dibenzofurans (HpCDF)	0.032
Octachlorinated dibenzo-p-dioxins (OCDD)	2.34
Octachlorinated dibenzofurans (OCDF)	0.032
TOTAL	9.52*

\*Total stack gas concentration of 9.52 ng/dscm is equivalent to a 2,3,7,8-TCDD concentration of 0.707 ng/dscm.

### Performance Data Assessment

The concentrations of PCBs in treated soil samples ranged from less than the reported detection limit (generally equal to 0.4 to 0.5 mg/kg) to 1.8 mg/kg. The concentrations of PCBs in treated soil samples were generally less than or equal to the detection limit of 0.4 to 0.5 mg/kg.

The level of dechlorination in the ATP unit was measured during the demonstration test conducted in September 1990 (see Appendix A), and the SITE Demonstration conducted in May 1991. The level of dechlorination was determined by comparing the quantity of PCBs entering the ATP system to the quantity of PCBs discharged from the ATP system via all effluent streams - the treated solids, stack gas, condensed water, and vapor scrubber oils, and assuming that the

difference in mass of PCBs is attributed to dechlorination. During the demonstration test, 4.3 pounds of PCBs entered the system and 1.05 pounds of PCBs were discharged, corresponding to a 76 percent dechlorination level (i.e., 76 percent of the mass of PCBs entering the system were dechlorinated). However, this figure does not account for dechlorination from the recycle of residual oil through the system. During the SITE Demonstration, 0.321 lb/hr of PCBs were fed to the ATP system and 0.00678 lb/hr of PCBs were discharged from the ATP system, corresponding to a 98 percent dechlorination level. [4, 9]

During the Demonstration Test, stack gas emission requirements were met for PCBs, PEG, and particulates.

## TREATMENT SYSTEM PERFORMANCE (CONT.)

### Performance Data Completeness

The performance data are suitable for characterizing the concentrations of PCBs in untreated and treated soil, and for comparing treatment performance with system design

and operation. The demonstration test and the SITE Demonstration test include paired, representative untreated and treated soil samples.

### Performance Data Quality

Approximately 10% of the treated soil samples collected during the treatment application at Wide Beach were split for analysis in both the on-site laboratory and the USACE's New England Division laboratory. The on-site laboratory results generally compared

well with the USACE results. In some instances the on-site laboratory results below 1 mg/kg PCBs showed a negative bias when compared to the USACE laboratory results; however, none of the data were rejected by the USACE. [20-23]

## TREATMENT SYSTEM COST

### Procurement Process

EPA and the USACE signed an interagency agreement for the procurement of an RA contractor. The interagency agreement specified that the USACE would be responsible for management and administration of the RA contract. The USACE retained Kimmins

Thermal Corporation to manage the remedial construction and treatment activities at the site. Kimmins subcontracted SoilTech, Inc., to treat the excavated contaminated soil at Wide Beach using the ATP/APEG dechlorination process. [8]

### Treatment Cost

Tables 6, 7, and 8 present the costs for the Thermal Desorption/Dehalogenation application at the Wide Beach Development Superfund Site. In order to standardize reporting of costs across projects, costs are shown in Tables 6, 7, and 8 according to the format for an interagency Work Breakdown Structure (WBS). The WBS specifies 9 before-treatment cost elements, 5 after-treatment cost elements, and 12 cost elements that provide a detailed breakdown of costs directly associated with treatment. Tables 6, 7, and 8 present the cost elements exactly as they appear in the WBS, along with the specific activities, and unit cost and number of units of the activity, as provided by EPA in the draft Applications Analysis Report.

In preparing the Applications Analysis Report, EPA obtained actual cost data from Soil Tech for treating 42,000 tons of soil at Wide Beach [9]. As shown in Table 6, the cost data show a total of \$11,600,00 for cost elements directly associated with treatment of the soil (i.e., excluding before- and after-treatment cost elements). This total treatment cost corresponds to \$280 per ton of soil treated. In addition, Tables 7 and 8 show that a total of \$908,000 for before-treatment and \$3,400,000 for after-treatment costs were incurred. There were no costs in this application for the following elements in the WBS: Liquid Preparation and Handling, Vapor/Gas Preparation and Handling, Pads/Foundations/

## TREATMENT SYSTEM COST (CONT.)

### Treatment Cost (Cont.)

Spill Control, Training, Operation (Long-term - over 3 years), Site Work, Surface Water Collection and Control, Groundwater Collection and Control, Air Pollution/Gas Collection and Control, Solids Collection and Containment, Liquids/Sediments/Sludges Collection

and Containment, Drums/Tanks/Structures/Miscellaneous Demolition and Removal, Decontamination and Decommissioning, Disposal (Other than Commercial), Site Restoration, and Demobilization.

Table 6. Costs Directly Associated with Treatment [9]\*

Cost Elements	Cost (dollars)
Solids Preparation and Handling —residuals and waste handling and transporting	736,000
Startup/Testing/Permits —permitting and regulatory	200,000
—startup	133,000
Operation (short-term - up to 3 years) —labor	3,800,000
—supplies and consumables	1,194,000
—utilities	913,000
—equipment repair and replacement	1982,000
Cost of Ownership —capital equipment	2,153,000
Demobilization	481,000
<b>TOTAL TREATMENT COST</b>	<b>11,600,000</b>

Calculated Cost per Ton of Soil Treated: \$280 per ton

\*Additional information on estimated costs is available in Reference 26.

Table 7. Before -Treatment Cost Elements

Cost Elements	Cost (dollars)
Mobilization and Preparatory Work —transport of ATP unit to site —initial setup —installing infrastructure for utilities —setup of decontamination facilities	588,000
Monitoring, Sampling, Testing, and Analysis	320,000

Table 8. After -Treatment Cost Elements [9]

Cost Elements	Cost (dollars)
Disposal (commercial)	3,400,000*

\* Calculated from a disposal cost of \$80/ton x 42,000 tons of soil treated.

## TREATMENT SYSTEM COST (CONT.)

### Cost Data Quality

Treatment cost information shown in Table 6 represents actual costs of the treatment application and was obtained from the

treatment vendor. No qualifications to the cost information were provided by the vendor. [9]

### Vendor Input [27,28]

According to the treatment vendor, in general, the costs for treatment using the SoilTech ATP system vary depending on the character of the waste material, with treatment costs ranging from \$150 to \$250 per ton for a 10-ton per hour ATP system. The factors identified by the vendor that affect costs include:

- Moisture content of feed material;
- Particle size;
- Hydrocarbon content;

- Material handling characteristics; and
- Chemical characteristics.

Vendor estimates for mobilization and demobilization costs for a 10-ton per hour system range from \$700,000 to \$1.5 million. In the three Superfund projects completed by the SoilTech ATP System since the Wide Beach project, no off-site disposal of treated solids has been required. In addition, treatment costs have been reduced by as much as 17% as a result of improved process efficiency.

## OBSERVATIONS AND LESSONS LEARNED

### Cost Observations and Lessons Learned

- The cost for treatment of 42,000 tons of soil at Wide Beach was \$11,600,000, or approximately \$280/ton. This value includes treatment

chemical costs, but does not include costs for a concrete pad for the ATP unit. Off-site disposal of treated soil from Wide Beach was \$80/ton.

### Performance Observations and Lessons Learned

- The SoilTech ATP System achieved the 2 mg/kg cleanup level for PCBs in soil. The concentrations of PCBs in treated soil were generally at or below the reported detection limit (0.5 mg/kg). These results were consistent with those shown in the demonstration test.
- Treatment of 42,000 tons of soil was completed in a one year period.

- During the demonstration test, stack gas emission requirements were met for PCBs, PEG, and particulates.
- The SITE Demonstration results indicated that about 98 percent of the PCBs were dechlorinated. This value is greater than the level of dechlorination calculated from the demonstration test results (76 percent, see Appendix A).

### Other Observations and Lessons Learned

- The system was shut down for about two months when the inner kiln of the ATP unit cracked due to mechanical and heat stresses during operation. The geometry and metallurgy of the inner kiln, and the burner and drive systems for the ATP unit were modified so that the unit could withstand

temperatures of up to 1,500° C in the combustion zone.

- A soil pretreatment system was added to the treatment system after the system was shut down to remove steel debris which interfered with the retort zone sand seal and conglomerated soil lodged in the feed hopper.

## OBSERVATIONS AND LESSONS LEARNED (CONT.)

### Other Observations and Lessons Learned (Cont.)

- The fiberglass woven bags used in the flue gas treatment system baghouse abraded when the bags were cleaned with an air pulse system. SoilTech later replaced the fiberglass woven bags with stronger felted glass bags which are more durable at higher temperatures. The modified bags did not abrade when the ATP system was later used to treat soil and sediment at the Outboard Marine Corporation Superfund Site.
- The treated solids could not be backfilled at the site because they were not as cohesive as the excavated soil. The vendor indicated that the loss of cohesion in the solids after treatment was possibly due to the high silt and clay content and the presence of expansive illite/smectite clay. While off-site disposal of treated soils was necessary for this application, no off-site disposal has been necessary in the three Superfund projects conducted since Wide Beach which used the SoilTech ATP system.
- The SITE Demonstration and a New York State Department of Environmental Conservation study indicated that the thermal and chemical treatment of soils at Wide Beach may have adversely affected the ability of the treated soils to support vegetation for the following reasons:
  - the average concentration of nitrogen was reduced from 733 in the untreated soil to 40 mg/kg in the treated solids during the SITE Demonstration;
  - the treated solids contained an elevated concentration of soluble salts due to the addition of the APEG reagents; and
  - the pH of the treated soil required adjustment.
- Additional information provided by the RPM and Contracting Officer concerning the procurement and contracting processes at the Wide Beach Development site (and other sites) is provided in Reference 30. Reference 30 is available from the U.S. EPA National Center for Environmental Publications and Information (NCEPI), P.O. Box 42419, Cincinnati, OH 45242; (fax orders only) (513) 489-8695.

## REFERENCES

1. Appendix D: Pilot Study Testing Report: KPEG Processing of Soils, Galson Remediation Corp; Final Design Report, Remedial Design, Ebasco Services, February 1989.
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## Analysis Preparation

This case study was prepared for the U.S. Environmental Protection Agency's Office of Solid Waste and Emergency Response, Technology Innovation Office. Assistance was provided by Radian Corporation under EPA Contract No. 68-W3-0001.

## APPENDIX A—DEMONSTRATION TEST

### Demonstration Test Purpose

The purpose of this test was to:

- Demonstrate that SoilTech's Anaerobic Thermal Processor (ATP) system combined with dechlorination chemistry could achieve treatment of polychlorinated biphenyl (PCB)-contaminated soil from the Wide Beach site to a cleanup level of less than 2 mg/kg PCBs.
- Demonstrate that the New York Department of Environmental Conservation (NYDEC) air emission standards could be achieved by the ATP system.
- Demonstrate that the concentrations of metals, herbicides, semivolatile organics, pesticides, and volatile organics measured in the Toxicity Characteristic Leachate Procedure (TCLP) extracts from the treated solids are less than the Toxicity Characteristic (TC) limits.
- Demonstrate that dechlorination of PCBs is occurring during the treatment process.
- Demonstrate that an average feed rate of 8 tons per hour is attainable by the ATP system.

### Demonstration Test Description

The treatment system used for the full-scale remediation of soil at the Wide Beach site was used for the demonstration test, as described in the ATP/APEG Process Description and Operation section of this report.

The demonstration scale test was conducted on September 7 and 8, 1990 and consisted of two phases. The first phase included processing of approximately 62 tons of contaminated soil through the treatment system and oc-

curred during the first ten hours of the test. The second phase included the processing of clean sand feed while recycling recovered oils containing PCBs with the dechlorination reagents. The second phase occurred during the last 11 hours of the demonstration. The purpose of the second phase was to collect data which showed that dechlorination was occurring during the treatment process by isolating the dechlorination of PCBs contained in the recycled water and oil.

### Demonstration Test Performance Data [4]

As shown in Tables A-1 and A-2, the demonstration scale test results indicated that the site cleanup goal for PCBs in soil (less than 2 mg/kg) and stack gas emissions requirements were achieved using the ATP dechlorination treatment system.

Analyses of the TCLP extracts from the treated solids indicated that metals, herbicides, semivolatile organics, pesticides, and volatile organics were not present in the extracts above the TC limits. Additionally, total petroleum hydrocarbons were not detected in the

Table A-1. Removal of PCBs from Contaminated Soil [4]

Concentration of PCBs in the Contaminated Feed Composite Sample (mg/kg)	Concentration of PCBs in the Treated Solids Composite Sample (mg/kg)	Cleanup Goal for PCBs in Soil (mg/kg)	Percent Removal (%)
25	<0.06	<2.0	>99



## APPENDIX A—DEMONSTRATION TEST (CONT.)

### Demonstration Test Performance Data [4] (Cont.)

Table A-2. Stack Gas Emissions [4]

Constituent	Requirement	Maximum Emission Levels
PCB (lb/hr)	$3.33 \times 10^{-5}$	$1.0 \times 10^{-5}$
PEG (lb/hr)	$4.16 \times 10^{-5}$	$4.0 \times 10^{-5}$
Particulates (gr/dscf)	0.05	0.04

treated solids (detection limit equal to 4.6 mg/Kg).

The occurrence of dechlorination was quantified by analyzing PCB material balance data for the demonstration test. During the first phase of the demonstration, approximately 4.3 pounds of PCBs were fed into the treatment system, 0.0151 pounds were discharged in the treated soils and stack emissions, and 1.03 pounds accumulated in the system (in process oil and water). The percentage of PCBs introduced into the treatment system that were dechlorinated is calculated by the following equation:

$$\text{Percentage of PCBs dechlorinated} = \frac{\text{PCBs introduced (pounds)} - [\text{PCBs discharged (pounds)} + \text{PCBs accumulated in the system (pounds)}]}{\text{PCBs introduced (pounds)}} \times 100$$

These results indicate that approximately 76 percent of the PCBs introduced into the system were dechlorinated during the first phase of the demonstration test.

During the first phase of the demonstration test, recovered oils were commingled with oils produced during the pretest run and reagent fuel. This increased the volume of oil to be recycled during the second phase. As a result, only 20% of the recovered oils could be recycled during the test. Consequently, the second phase of the demonstration test could not provide conclusive evidence of dechlorination of the recycled oils.

During the first phase of the demonstration test, 61.66 tons of contaminated soil were treated in the ATP system in 7.62 hours. This corresponds to an average feed rate of 8.1 tons per hour (tph). The maximum feed rate during the first phase of the demonstration test was 8.92 tph for approximately 1.5 hours.

### Demonstration Test Lessons Learned


- The SoilTech ATP/dechlorination system achieved the site cleanup goal for PCBs in soil (less than 2 mg/Kg) during the demonstration test. PCBs were reduced from 25 mg/kg to less than the 0.06 mg/kg reported detection limit.
- Metals, herbicides, semivolatile organics, pesticides and volatile organics in the TCLP extracts for the treated solids were measured at concentrations which were less than the TC limits.
- PCB material balance data indicated that approximately 76 percent of the PCBs introduced into the treatment system were dechlorinated in the first phase of the demonstration test. This figure underestimates the ability of the system to dechlorinate PCBs because it does not take into account the recycling of residual oil through the system.
- The ATP system maintained an average operating rate of 8.1 tph during the first phase of the demonstration test.

# **COST AND PERFORMANCE REPORT**

**Thermal Desorption/Dehalogenation  
at the  
Wide Beach Development Superfund Site  
Brant, New York**

*Prepared By:*

*U.S. Environmental Protection Agency  
Office of Solid Waste and Emergency Response  
Technology Innovation Office*



**March 1995**

### **Notice**

Preparation of this report has been funded wholly or in part by the U.S. Environmental Protection Agency under Contract Number 68-W3-0001. It has been subject to administrative review by EPA headquarters and Regional staff and by the technology vendor. Mention of trade names for commercial products does not constitute endorsement or recommendation for use.